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FOR: AGING METHOD AND AGING DEVICE OF PLASMA DISPLAY PANEL

VERIFICATION OF A TRANSLATION

Assistant Commissioner for Patents
Washington, D.C. 20231
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I, the below named translator, hereby declare that:

1. My name and post office address are as stated below.

2. That I am knowledgeable in the English language and in the language of JP2003-199265, and I believe the attached English translation to be a true and complete translation of JP 2003-199265.

3. The document for which the attached English translation is being submitted is a patent application on an invention entitled AGING METHOD AND AGING DEVICE OF PLASMA DISPLAY PANEL.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: May 8, 2008

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[Title of the Invention] Aging Device and Aging Method for Plasma Display Panel

[Claims]

[Claim 1]

An aging device for plasma display panel, which performs aging discharge by applying a specified voltage to a plasma display panel and comprises a blower for sending air to the panel surface during aging, wherein the temperature within the display region of the panel is kept uniform by the air from the blower.

[Claim 2]

The aging device for plasma display panel of claim 1, comprising a plurality of blowers, wherein a blowing direction changeable means for changing the blowing direction is disposed between the plurality of blowers and the panel.

[Claim 3]

The aging device for plasma display panel of claim 1, wherein the blower is moved during aging.

[Claim 4]

The aging device for plasma display panel of claim 1, wherein the blower changes its blowing direction during aging.

[Claim 5]

The aging device for plasma display panel of claim 1, wherein the blower changes its rotating speed during aging.

[Claim 6]

An aging method for plasma display panel in which aging discharge is performed by applying a specified voltage to the plasma display panel, wherein a plurality of blowers are disposed to send air to the panel surface, and aging is performed while sending air to the panel surface so that the temperature is kept uniform within the display region of the panel.

[Claim 7]

The aging method for plasma display panel of claim 6, wherein a blowing direction changeable means is disposed between the panel and the plurality of blowers, and the blowing direction is changed by the blowing direction changeable means during aging.

[Claim 8]

The aging method for plasma display panel of claim 6, wherein the blower is moved during aging.

[Claim 9]

The aging method for plasma display panel of claim 6, wherein the blowing direction of the blower is changed during aging.

[Claim 10]

The aging method for plasma display panel of claim 6, wherein the rotating speed of the blower is changed during aging.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an aging device and aging method for plasma display panel which performs image display with plasma generated by discharge between electrodes.

[0002]

[Background Art]

Plasma display panel is a display device with excellent visibility which is characterized in that the screen is large and also the panel is thin and light-weight. AC type and DC type are available as the discharge systems of plasma display panel, and three-electrode surface discharge type and opposed discharge type are available as electrode structures. At present, AC type three-electrode plasma display panel which is AC type and surface discharge type is mainly employed because of being suited for very fine structures and easy to manufacture.

[0003]

In an AC surface discharge type plasma display panel, as shown in Fig. 7, a plurality of striped display electrodes 4 having scanning electrode 2 and sustaining electrode 3 paired with each other are formed on clear front substrate 1 such as a glass board, and dielectric layer 5 is formed so as to cover the display electrode 4, and protective layer 6 is formed on the dielectric layer 5.

[0004]

Also, a plurality of striped address electrodes 9 covered with insulating layer 8 are formed on rear substrate 7 so as to be two-level crossing with display electrode 4. A plurality of partition walls 10 are disposed on insulating layer 8 between address electrodes 9 in such manner as to be parallel with address electrodes 9, and fluorescent layer 11 is disposed on insulating layer 8 between partition walls 10.

[0005]

Substrate 1 and substrate 7 are opposed to each other with a slight discharge space therebetween so that display electrode 4 and address electrode 9 are perpendicularly crossed with each other and also sealed therearound. And in the discharge space, for example, a mixed gas of neon (Ne) and xenon (Xe) is sealed as discharge gas. Also, the discharge space is divided into a plurality of divisions by partition walls 10, and red, green and blue fluorescent layers 11 are disposed by one color each in order in each division. And, a discharge cell is formed at a portion where display electrode 4 and address electrode 9 are crossing with each other, and the region where the discharge cell exists in the panel is the display region.

[0006]

In a plasma display panel having such a configuration, at the discharge cell which serves to display, scanning pulses are applied to scanning electrode 2 and simultaneously writing pulses are applied to address electrode 9, and thereby, address discharge is performed between scanning electrode 2 and address electrode 9. After that, sustaining pulses alternately reversed are periodically applied between scanning electrode 2 and sustaining electrode 3, and thereby, the specified display is obtained by performing sustaining discharge between scanning electrode 2 and sustaining electrode 3 at the discharge cell that performed address discharge.

[0007]

Also, such a plasma display panel is generally formed of two parts, that is, a front panel and a rear panel, and is manufactured as described in the following.

[0008]

First, the front panel is manufactured by such a method that a bus electrode is formed by printing and burning an electrode material such as silver (Ag) after forming an electrode of transparent conductive film on substrate 1, thereby providing scanning electrode 2 and sustaining electrode 3, on which dielectric glass material is applied and burnt to form dielectric layer 5, and after that, protective layer 6 is formed by evaporation of magnesium oxide (MgO).

[0009]

On the other hand, the rear panel is manufactured by such a method that insulating layer 8 is formed by applying and burning a glass material after forming address electrode 9 by printing and burning an electrode material such as Ag on substrate 7, and subsequently, partition wall 10 is formed on insulating layer 8 so as to be positioned between address electrodes 9, and further, fluorescent layer 11 is formed by applying and burning a fluorescent material between partition walls 10.

[0010]

In this way, after going through each specified process, sealing glass frit is applied onto the periphery of the rear panel, and after putting it on the front panel, a sealing process for heating and melting the sealing glass frit is executed, thereby sealing the peripheral portions of the front panel and the rear panel with sealing glass. Subsequently, an exhaust process for exhausting inside the discharge space formed between the front panel and the rear panel. After that, a plasma display panel is assembled by sealing discharge gas into the discharge space with a specified pressure.

[0011]

Immediately after assembling in this way, the plasma display panel is generally high in operation voltage (voltage necessary for uniformly lighting the entire panel), and the discharge itself is unstable. Accordingly, as mentioned in Patent document 1 for example, in the plasma display panel manufacturing process, alternation voltage is applied between scanning electrode 2 and sustaining electrode 3 in particular to perform aging by forcible discharge (aging discharge) in all the discharge cells over the specified time, thereby lowering the operation voltage and making the discharge characteristic uniform and stable. Also, a fan is installed above the panel, and the panel is cooled by the fan.

[0012]

[Patent document 1]

Unexamined Japanese Patent Publication 2002-231139.

[0013]

[Problems to be Solved by the Invention]

However, in case aging is performed while cooling the panel by using a fan, the color of the display image sometimes becomes uneven when the panel is lighted.

[0014]

The present invention is intended to solve such a problem, and the object of the invention is to provide an aging device and aging method with which it is possible to obtain a plasma display panel reduced in generation of uneven color and enhanced in display quality.

[0015]

[Means to Solve the Problems]

The inventor et al have examined the cause of generation of uneven colors of display images, and obtained the following results.

[0016]

Generally, a plasma display panel is diagonally as large as 32 inches to 60 inches, and therefore, a plurality of fans are arranged to send air to the panel surface for the purpose of cooling the panel. In this case, as a result of detailed examination of the temperature distribution during the aging, it has been found that cooling by using a plurality of fans creates distribution of the air flow on the panel surface (that is, the air flow is smooth on some portions and it is not smooth but stagnant on some portions), causing a high-temperature region and a low-temperature region to be generated close to each other within the display region of the panel, and as a result, remarkable temperature difference is easier to be generated between portions at a short distance from each other.

[0017]

And, since the discharge start voltage between electrodes in the panel varies depending upon the panel temperature, there arises a difference in easiness of aging because of the temperature difference within the display region of the panel at the time of aging. That is, because the discharge start voltage is low in high temperature regions, more discharge current flows even when the voltage applied is at a same level, causing the aging to advance and the discharge start voltage to become lower. On the other hand, the discharge start voltage is high in low temperature regions, the discharge current is less and also the aging operation is slower as

compared with that in high temperature regions. Accordingly, in high temperature regions, the aging is increasingly operated, while in low temperature regions, the aging operation is slower, and at the end of aging, the difference in discharge start voltage remains at a greater level in the display region of the panel. Due to such a difference in discharge start voltage, there arises a difference in discharge current or difference in luminance even during panel operation, causing the color to become uneven and the display quality to be greatly lowered. Particularly, the appearance of uneven color is remarkable when the high temperature region and low temperature region are close to each other.

[0018]

As described above, when the panel is cooled by using a plurality of fans during aging, the air flow on the panel surface is distributed and the temperature difference becomes greater in the display region of the panel. Also, the high temperature region and low temperature region are close to each other, and consequently, uneven color is generated in the image displayed on the panel, causing the display quality to be greatly lowered, and this finding led us to make the present invention.

[0019]

The aging device of the present invention for performing aging discharge by applying a specified voltage to the plasma display panel is configured in that there is provided a blower which sends air to the panel surface during aging, and the temperature within the display region of the panel is kept uniform by the air from the blower.

[0020]

Also, the aging method of the present invention for performing aging discharge by applying a specified voltage to the plasma display panel is characterized in that there are provided a plurality of blowers which send air to the panel surface, and aging is performed while sending air to the panel surface so that the temperature is kept uniform within the display region of the panel.

[0021]

[Description of the Preferred Embodiments]

The invention of claim 1 of the present invention is an aging device for plasma display panel, which performs aging discharge by applying a specified voltage to a plasma display panel and comprises a blower for sending air to panel surfaces during aging, wherein the temperature within the display region of the panel is kept uniform by the air from the blower.

[0022]

The invention of claim 2 is the invention of claim 1, comprising a plurality of blowers, wherein a blowing direction changeable means for changing the blowing direction is disposed between the plurality of blowers and the panel.

[0023]

The invention of claim 3 is the invention of claim 1, wherein the blower is moved during aging.

[0024]

The invention of claim 4 is the invention of claim 1, wherein the blower changes its blowing direction during aging.

[0025]

The invention of claim 5 is the invention of claim 1, wherein the blower changes its rotating speed during aging.

[0026]

The invention of claim 6 is an aging method for plasma display panel in which aging discharge is performed by applying a specified voltage to the plasma display panel, wherein a plurality of blowers are disposed to send air to panel surfaces, and aging is performed while sending air to the panel surface so that the temperature is kept uniform within the display region of the panel.

[0027]

The invention of claim 7 is the invention of claim 6, wherein a blowing direction changeable means is disposed between the panel and the plurality of blowers, and the blowing direction is changed by the blowing direction changeable means during aging.

[0028]

The invention of claim 8 is the invention of claim 6, wherein the blower is moved during aging.

[0029]

The invention of claim 9 is the invention of claim 6, wherein the blowing direction of the blower is changed during aging.

[0030]

The invention of claim 10 is the invention of claim 6, wherein the rotating speed of the blower is changed during aging.

[0031]

One preferred embodiment of the present invention will be described

in the following with reference to the drawings. In the present invention, with respect to the panel configuration and manufacturing process, the contents are same as those described above, and the description is omitted except for the aging process.

[0032]

(Preferred embodiment 1)

Fig. 1 is a schematic plan view showing a state of aging with use of an aging device for plasma display panel in the preferred embodiment 1 of the present invention. Fig. 2 is a schematic diagram of the cross-section as viewed along the A - A' line of Fig. 1. In the present preferred embodiment, the panel is cooled by a fan disposed above the panel, but the fan is not shown in Fig. 1.

[0033]

As shown in Fig. 1, scanning electrodes 2 (X1, X2, ... , Xn) of panel 12 are connected in common by shorting means 13, sustaining electrodes 3 (Y1, Y2, ... , Yn) are connected in common by shorting means 14, and address electrodes 9 (A1, A2, ... , Am) are connected in common by shorting means 15. And, scanning electrode 2 and sustaining electrode 3 are connected to aging power source 16 via shorting means 13 and shorting means 14 respectively, and address electrode 9 is grounded via shorting means 15. It is allowable to apply voltage pulse to address electrode 9 or to keep address electrode 9 in a state of being suspended.

[0034]

As shown in Fig. 2, panel 12 is disposed on back plate 17 being high in heat conductivity (practically 0.5W/m·K or over in heat conductivity), and

a plurality of fans 18 as blowers are securely disposed in specified positions above panel 12. Also, louver 19 is disposed between panel 12 and fan 18, and louver 19 changes its angle in a predetermined period (for example, ranging from one second to one minute). For example, louver 19 swings to the right and left as shown by the arrow in Fig. 2. In this way, the aging device of the present preferred embodiment includes a plurality of fans 18 and louvers 19.

[0035]

During aging, the air is applied to the surface of panel 12 from fan 18 via louver 19. Louver 19 is a blowing direction changeable means for changing the direction of air from fan 18, and the air from fan 18 is evenly applied to the surface of panel 12 so that the air will not stagnate. Accordingly, using louver 19, the temperature in the display region of panel 12 can be kept uniform and it is possible to suppress the generation of a low temperature region and a high temperature region within a short distance.

[0036]

Fig. 3 shows waveforms of voltage pulses outputted from aging power source 16. Rectangular pulses of voltage Vs (frequency: 20kHz to 100kHz) are alternately outputted, and discharge (aging discharge) is generated between scanning electrode 2 and sustaining electrode 3.

[0037]

A specific example of aging by using the aging device in the present preferred embodiment will be described in the following.

[0038]

Panel 12 used here is diagonal 42 inches in size and 1028 x 768 (that

is, m = 1028, n = 768) in pixel. The gas sealed in panel 12 is a mixed gas of Ne and Xe, and the volume ratio of Xe in the mixed gas is 10% to 40%. The aging time is 8 hours, and Vs during aging is 450V constant, and the aging is performed while changing the direction of air from fan 18 by using louver 19. After the aging, the display characteristic of panel 12 of the present exemplary embodiment has been examined to find that the voltage required for uniform lighting of the entire panel is 185V and the display characteristic in the panel is uniform at this voltage without uneven color or difference between light and darkness, thereby ensuring excellent display quality.

[0039]

As a comparative example, using panel 12 the same as mentioned above, aging has been performed without operating louver 19 so that the direction of air from fan 18 is not changed by louver 19. The aging has been performed under the same conditions as mentioned above except that louver 19 is secured and the display characteristic has been similarly examined with respect to the panel of this comparative example as well. As a result, the discharge start voltage within the display region is greatly distributed and it is necessary to increase the voltage up to 195V for nearly uniformly lighting the entire panel. Also, at this voltage, regions a little colored with Magenta or yellow can be observed in all-white display, and the display quality is obviously poorer as compared with the panel of the present exemplary embodiment.

[0040]

In order to find the cause of this difference, the temperature

distribution within the display region of the panel during aging has been examined to find that in the panel of the comparative example, the temperature is 83±20℃ when the temperature rise is nearly saturated, while in the panel of the present exemplary embodiment, it is 76±10℃. Thus, as compared with the panel of the comparative example, in the case of the panel of the present exemplary embodiment, the temperature of the display region can be kept uniform. In addition, in the panel of the comparative example, low temperature portions are high in discharge start voltage in the evaluation of display characteristic, which nearly correspond to portions where uneven color is generated.

[0041]

As described above, during aging, the air blow for cooling is properly changed so that the air will not stagnate on the panel surface, and thereby, the temperature in the display region of the panel can be kept uniform, and it is possible to perform the aging more uniformly as compared with the case of operation without louver 19.

[0042]

The position and the number of fans 18 are properly set according to the size of panel 12 and the size of fan 18. Also, in Fig. 1, the moving direction of louver 19 is parallel to scanning electrode 2 or sustaining electrode 3, but it is possible to properly set the moving direction.

[0043]

(Preferred embodiment 2)

Fig. 4 is a structural diagram showing the outline of the aging device in the preferred embodiment 2 of the present invention. In this aging

device, fan 18 is disposed above panel 12 placed on back plate 17, and it is configured so that fan 18 can be moved. During aging, fan 18 moves on panel 12 in a predetermined period (for example, ranging from one second to one minute). For example, in Fig. 4, fan 18 reciprocates to the right and left. In this way, the air from fan 18 is evenly applied to the surface of panel 12 so that the air will not stagnate. Accordingly, the temperature within the display region of the panel surface can be kept uniform and it is possible to suppress the generation a low temperature region and a high temperature region within a short distance.

[0044]

With respect to a panel subjected to aging with use of the aging device, the display characteristic has been examined in the same way as in the preferred embodiment 1 to find that the display quality is excellent the same as in the case of preferred embodiment 1.

[0045]

When one piece of fan 18 is used, it is preferable to move the fan 18 so that the air can be applied to the entire surface of panel 12. Also, when a plurality of fans 18 are used, for example, it is preferable to arrange the plurality of fans 18 in an alternate fashion and to change the moving direction or to arrange the plurality of fans 18 in a single row and to move them in the same direction. It is possible to properly select the arrangement and the moving direction of fan 18. Further, it is allowable to make the moving speeds of individual fans different from each other. Also, it is allowable not only to linearly move the fans 18 but to move them along a closed curve like a circle or oval. Naturally, the layout and the number of

fans 18 are properly selected in accordance with the size of panel 12 and the size of fan 18.

[0046]

(Preferred embodiment 3)

Fig. 5 is a structural diagram showing the outline of the aging device in the preferred embodiment 3 of the present invention. In this aging device, fan 18 is disposed above the panel 12 placed on back plate 17, and the facing direction of fan 18 can be changed. During aging, fan 18 makes a oscillating motion on panel 12 in a predetermined period (for example, ranging from one second to one minute). For example, in Fig. 5, it makes a oscillating motion to the right and left. In this way, the air from fan 18 is evenly applied to the surface of panel 12 so that the air will not stagnate. Accordingly, the temperature in the display region of the panel surface can be kept uniform and it is possible to suppress the generation of a low temperature region and a high temperature region within a short distance.

[0047]

With respect to a panel subjected to aging with use of the aging device, the display characteristic has been examined in the same way as in the preferred embodiment 1 to find that the display quality is excellent the same as in the case of preferred embodiment 1.

[0048]

When one piece of fan 18 is used, it is preferable to oscillate the fan 18 so that the air can be applied to the entire surface of panel 12. Also, it is preferable to properly arrange a plurality of fans 18 and to let them oscillate in same direction or different directions. Same effects can be obtained with

the oscillating direction set linearly or circularly. Also, when a plurality of fans are used, it is allowable to oscillate them in same or different periods. Naturally, the layout and the number of fans are properly set in accordance with the size of panel 12 and the size of fan 18.

[0049]

(Preferred embodiment 4)

Fig. 6 is a structural diagram showing the outline of the aging device in the preferred embodiment 4 of the present invention. In this aging device, a plurality of fans 18 are disposed above the panel 12 placed on back plate 17, and it is configured in that the rotating speeds of individual fans 18 are changed. During aging, the rotating speed of fan 18 is changed in a predetermined period (for example, ranging from ten seconds to ten minutes). In this case, the rotating speed of fan 18 is changed for example in a range of 0 rpm to 5000 rpm. In this way, the air from fan 18 is evenly applied to the surface of panel 12 so that the air will not stagnate. Accordingly, the temperature within the display region of the panel surface can be kept uniform, and it is possible to suppress the generation of a low temperature region and a high temperature region within a short distance.

[0050]

It is also preferable to change the rotating speed at random instead of periodically changing the rotating speed of fan 18. Also, how to operate the fan 18 can be properly selected for example in such manner that a plurality of fans 18 are divided into two groups, and fans 18 of the first group are rotated and at the same time fans 18 of the second group are stopped, and subsequently, fans 18 of the first group are stopped and at the

same time fans 18 of the second group are rotated, repeating the operations alternately.

[0051]

With respect to a panel subjected to aging with use of the aging device, the display characteristic has been examined in the same way as in the preferred embodiment 1 to find that the display quality is excellent the same as in the case of preferred embodiment 1.

[0052]

Also, with respect to a plurality of fans 18, it is desirable to change the rotating speeds with time differences respectively provided or to make the changing period different from each other because the air will not stagnate. However, when a plurality of fans 18 used are synchronized in change of the rotating speed, the air current will become easier to stagnate, and therefore, it is desirable not to make them synchronized in change of the rotating speed. Also, regarding the method of changing the rotating speed, it is preferable to use 1/f sway or $1/f^2$ sway. Naturally, the layout and the number of fans are properly selected in accordance with the size of panel 12 and the size of fan 18.

[0053]

In each of the preferred embodiments described above, in order to keep the panel temperature uniform at a lower temperature level during aging, it is allowable to make a plate having excellent heat conductivity the same as the back plate come in tight contact with the upper surface of panel 12 placed on back plate 17. Also, it becomes easier to lower the temperature when fan 18 is disposed under back plate 17 as well in order to

cool the back plate 17.

[0054]

Also, in case a heat insulating member with low heat conductivity (practically 0.1W/m·K or less in heat conductivity) is used as back plate 17, the panel temperature will increase during aging, but it is possible to obtain same effects as mentioned above provided that the temperature within the display region of the panel is uniformly distributed by using the present invention.

[0055]

Further, in each of the preferred embodiments described above, the gas sealed in the panel is a mixed gas of Ne and Xe being 10% to 40% in volume ratio, but even in case Xe sealed in the panel is less than 10%, the same effects as mentioned above can be obtained by using the present invention. In that case, even in case the temperature distribution within the display region of the panel during aging is ±15℃ in width, there is no generation of uneven color. When the concentration of Xe is low, as compared with the case of Xe being high in concentration, uneven color is less observed even in case the temperature distribution within the display region of the panel during aging is a little greater. This is probably because the operation voltage is lower, the level of discharge current is lower, and the luminance is lower as compared with the case of higher concentration of Xe. Accordingly, when the concentration of Xe becomes higher in particular, it is necessary to make the temperature distribution within the display region of the panel during aging more uniform, and therefore, it is effective to use the present invention. Also, with respect to

panels whose gas composition is other than Ne - Xe, same effects can be obtained by using the present invention.

[0056]

[Advantages of the Invention]

As described above, it is possible to manufacture a high-quality plasma display panel being free from uneven color by using the present invention.

[Brief Description of the Drawings]

Fig. 1 is a schematic plan view showing a state of aging executed by using the aging device in the preferred embodiment 1 of the present invention.

Fig. 2 is a schematic diagram of the aging device in the preferred embodiment 1 of the present invention.

Fig. 3 is a waveform chart showing aging voltage used on one preferred embodiment of the present invention.

Fig. 4 is a schematic diagram of the aging device in the preferred embodiment 2 of the present invention.

Fig. 5 is a schematic diagram of the aging device in the preferred embodiment 3 of the present invention.

Fig. 6 is a schematic diagram of the aging device in the preferred embodiment 4 of the present invention.

Fig. 7 is a perspective view showing a part of the plasma display panel.

[Description of the Reference Numerals and Signs]

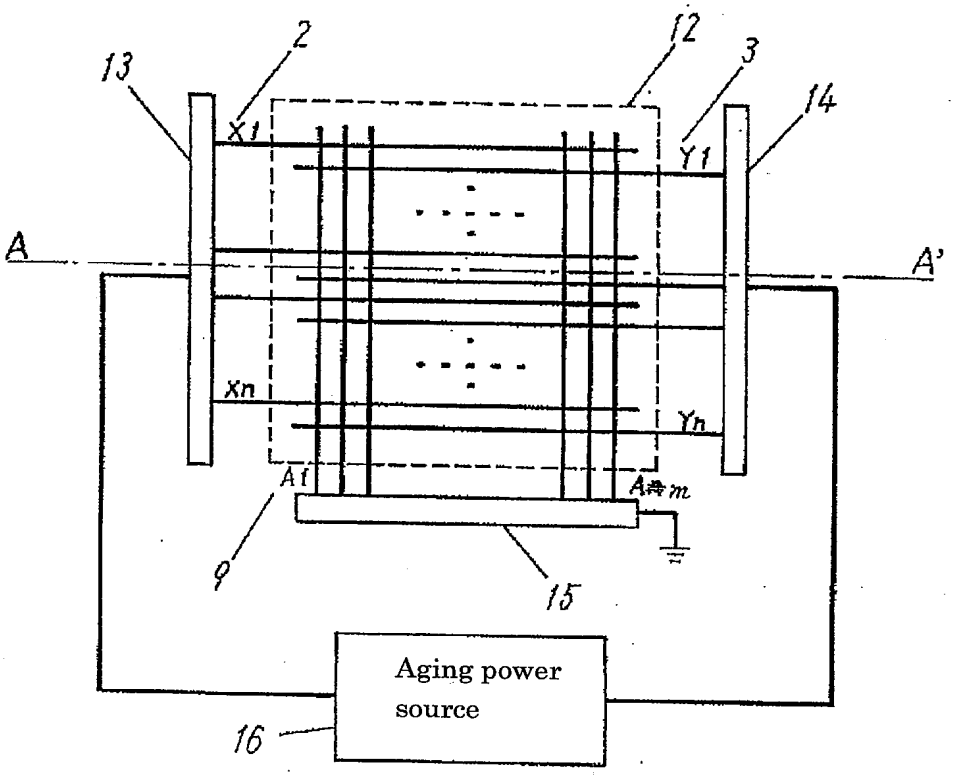
12 Plasma display panel

18 Fan (blower)

19 Louver (blowing direction changeable means)

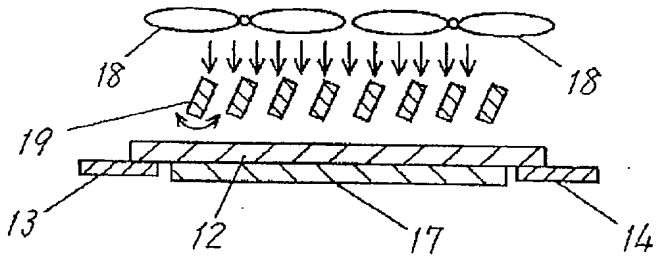
[Name of the Document] Drawing

[Fig. 1]

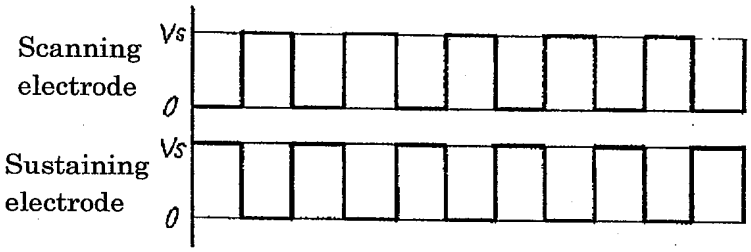


[Fig. 2]

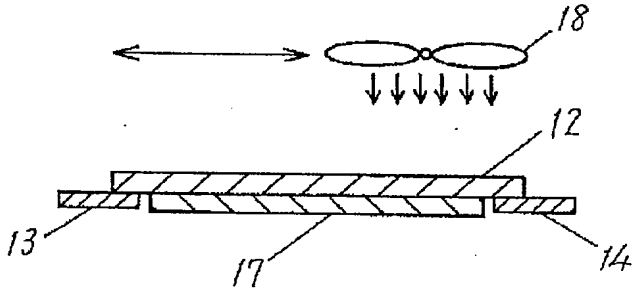
12 Plasma display panel
18 Blower
19 Blowing direction changeable means



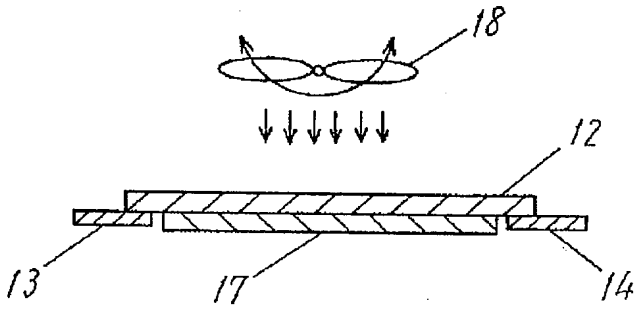
[Fig. 3]



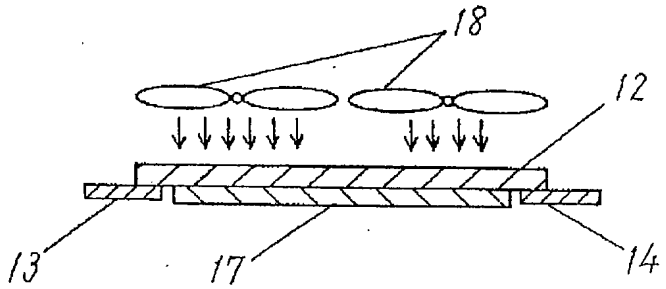
[Fig. 4]



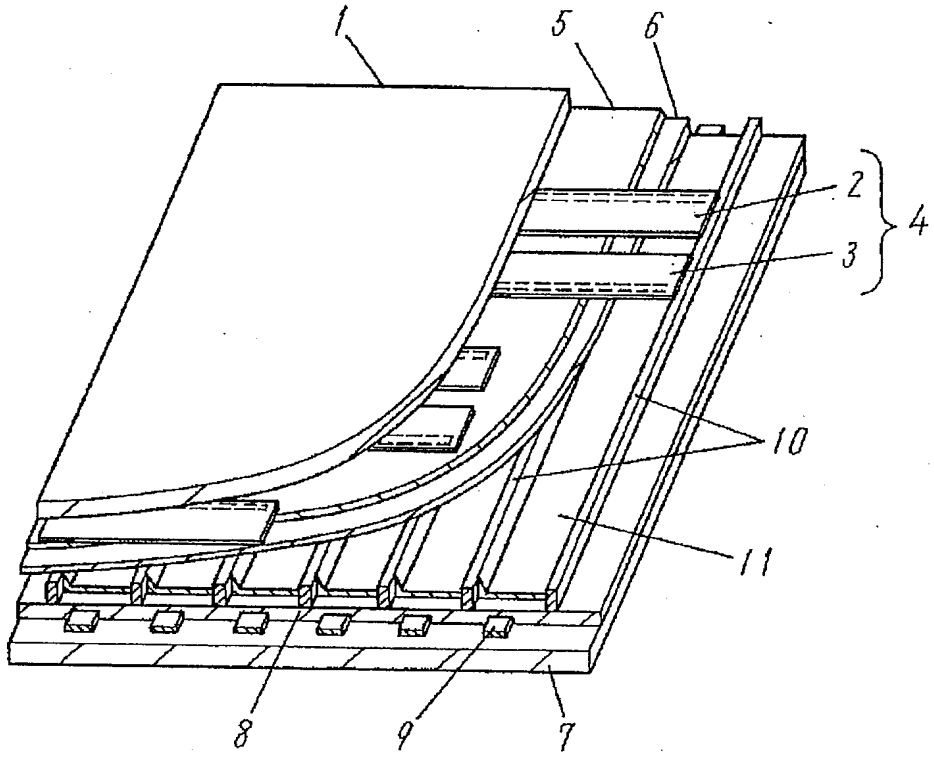
[Fig. 5]



[Fig. 6]



[Fig. 7]



[Name of the Document] Abstract

[Abstract]

[Object] The object of the invention is to provide an aging device and aging method by which a high-quality plasma display panel capable of suppressing the generation uneven color can be obtained.

[Means to Solve the Problems] An aging device for performing aging discharge by applying a specified voltage to plasma display panel 12, comprising blower 18 for sending air to the surface of panel 12 during aging, wherein the temperature within the display region of the panel is kept uniform by the air from blower 18. For example, blowing direction changeable means 19 is disposed between a plurality of blowers 18 and panel 12.

[Selected Drawing] Fig. 2